

CLAIMS

What is claimed is:

5 In a computer controlled graphics display system wherein objects are represented by data structures defining: the orientation and location of a plurality of polygons; and texture data defining surface characteristics of said object, said data structures at least partially stored in computer memory prior to rendering on a display screen, a method for

10 subdividing polygons having a high degree of perspective, said method comprising the steps of:

 (a) selecting, from said computer memory, a selected polygon from said plurality of polygons that at least partially define a depiction of said object, said selected polygon comprising at least three vertices wherein each vertex has a perspective term, W, associated therewith that defines a display perspective of said associated vertex with respect to a given viewing angle;

15 (b) determining perspective ratios for each pair of adjacent vertices of said at least three vertices of said selected polygon;

20 (c) subdividing said selected polygon to generate a plurality of new polygons provided any of said perspective ratios exceeds a preselected perspective threshold amount; and

 (d) rendering and displaying said selected polygon on a display screen of said computer controlled graphics display system provided none of

25 said perspective ratios exceeds said preselected perspective threshold amount.

25

2. A method as described in Claim 1 further comprising the step of: (e) repeating said steps of (a)-(c) for each new polygon generated by said step (c).

5 3. A method as described in Claim 1 wherein said step (c) comprises the steps of:

(c1) dividing said selected polygon into four new polygons provided three edges of said selected polygon have perspective ratios exceeding said preselected threshold amount;

10 (c2) dividing said selected polygon into three new polygons provided only two edges of said selected polygon have perspective ratios exceeding said preselected threshold amount; and

15 (c3) dividing said selected polygon into two new polygons provided only one edge of said selected polygon has a perspective ratio exceeding said preselected threshold amount.

4. A method as described in Claim 3 wherein said step (c1) comprises the step of inserting three mid-points between adjacent vertex pairs of said selected polygon to constitute new vertices for said four new polygons, wherein said step (c2) comprises the step of inserting two mid-points between adjacent vertex pairs of said selected polygon to constitute new vertices for said three new polygons, and wherein said step (c3) comprises the step of inserting one mid-point between an adjacent vertex pair of said selected polygon to constitute a new vertex for said two new polygons.

25 5. A method as described in Claim 4 further comprising the step of determining data for each inserted midpoint resultant from said steps (c1), (c2), and (c3), said data comprising: three dimensional coordinate values (x,

y, z); texture map coordinate values (u, v); color (R, G, B); and perspective terms (W).

6. A method as described in Claim 5 wherein said step of

5 determining data for each inserted midpoint comprises the steps of:

(1) calculating a perspective term, Wmid, for a midpoint of a given adjacent pair of vertices, A and B, in accordance with:

$$W_{mid} = (W_A + W_B) / 2$$

where WA and WB denote perspective terms for said vertices A and B,

10 respectively;

(2) calculating intermediate variables, a and a', in accordance with:

$$a = u_A * W_A$$

$$a' = v_A * W_A$$

where uA and vA respectively denote the u-axis and v-axis texture

15 coordinates for said vertex A;

(3) calculating intermediate variables, b and b', in accordance with:

$$b = u_B * W_B$$

$$b' = v_B * W_B$$

where uB and vB respectively denote the u-axis and v-axis texture

20 coordinates for said vertex B;

(4) calculating intermediate variables, c and c', in accordance with:

$$c = (a + b) / 2$$

$$c' = (a' + b') / 2; \text{ and}$$

(5) calculating umid and vmid in accordance with:

25 $umid = c / W_{mid}$

$$vmid = c' / W_{mid}$$

where umid and vmid are the texture coordinates for said midpoint.

27

7. A method as described in Claim 1 wherein for a given pair of adjacent vertices, A and B, said step (b) comprises the steps of:

(b1) dividing a perspective term associated with vertex A with a perspective term associated with adjacent vertex B to obtain a first perspective ratio associated with said given pair of adjacent vertices; and

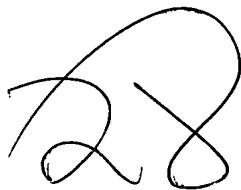
(b2) dividing said perspective term associated with vertex B with said perspective term associated with adjacent vertex A to obtain a second perspective ratio associated with said given pair of adjacent vertices.

10 8. A method as described in Claim 1 wherein said preselected threshold is between the range of 1.25 to 1.5.

9. A method as described in Claim 1 further comprising the step of receiving said preselected threshold amount from a user defined adjustment.

15 10. In a computer controlled graphics display system having a processor coupled to bus, and a graphics subsystem coupled to said bus, and wherein objects are represented by a plurality of polygons and texture data defining surface characteristics of object, a computer readable memory unit coupled to said bus and storing instructions therein that when executed causing said system to implement a method for subdividing polygons having a high degree of perspective, said method comprising the steps of:

(a) selecting, from said computer memory, a selected polygon from said plurality of polygons that at least partially define a depiction of said object, said selected polygon comprising at least three vertices wherein each vertex has a perspective term, W, associated therewith that defines a display perspective of said associated vertex with respect to a given viewing angle;



- (b) determining perspective ratios for each pair of adjacent vertices of said at least three vertices of said selected polygon;
- (c) subdividing said selected polygon to generate a plurality of new polygons provided any of said perspective ratios exceeds a preselected perspective threshold amount; and
- (d) rendering and displaying said selected polygon on a display screen of said computer controlled graphics display system provided none of said perspective ratios exceeds said preselected perspective threshold amount
- (e) repeating said steps (a)-(d) for each polygon of said plurality of polygons.

11. A computer readable memory unit as described in Claim 10
wherein said method further comprises the step of: (f) repeating said steps of
15 (a)-(c) for each new polygon generated by said step (c).

12. A computer readable memory unit as described in Claim 10
wherein said step (c) comprises the steps of:
20 (c1) dividing said selected polygon into four new polygons provided
three edges of said selected polygon have perspective ratios exceeding
a preselected threshold amount;
(c2) dividing said selected polygon into three new polygons provided
only two edges of said selected polygon have perspective ratios
exceeding said preselected threshold amount; and
25 (c3) dividing said selected polygon into two new polygons provided
only one edge of said selected polygon has a perspective ratio exceeding
said preselected threshold amount.

13. A computer readable memory unit of Claim 12 wherein said step (c1) comprises the step of inserting three mid-points between adjacent vertex pairs of said selected polygon to constitute new vertices for said four new polygons, wherein said step (c2) comprises the step of inserting two
5 mid-points between adjacent vertex pairs of said selected polygon to constitute new vertices for said three new polygons, and wherein said step (c3) comprises the step of inserting one mid-point between one adjacent vertex pair of said selected polygon to constitute a new vertex for said two new polygons.

10

14. A computer readable memory unit as described in Claim 13 wherein said method further comprises the step of determining data for each inserted midpoint as a result of said steps (c1), (c2), and (c3), said data comprising: three dimensional coordinate values (x, y, z); texture map
15 coordinate values (u, v); color (R, G, B); and perspective terms (W).

15. A computer readable memory unit as described in Claim 14 wherein said step of determining data for each inserted midpoint comprises the steps of:

20 (1) calculating a perspective term, Wmid, for a midpoint of a given adjacent pair of vertices, A and B, in accordance with:

$$W_{mid} = (W_A + W_B) / 2$$

where WA and WB denote perspective terms for said vertices A and B, respectively;

25 (2) calculating intermediate variables, a and a', in accordance with:

$$a = u_A * W_A$$

$$a' = v_A * W_A$$

where uA and vA respectively denote the u-axis and v-axis texture coordinates for said vertex A;

30

(3) calculating intermediate variables, b and b', in accordance with:

$$b = uB * WB$$

$$b' = vB * WB$$

where uB and vB respectively denote the u-axis and v-axis texture

5 coordinates for said vertex B;

(4) calculating intermediate variables, c and c', in accordance with:

$$c = (a + b) / 2$$

$$c' = (a' + b') / 2; \text{ and}$$

(5) calculating umid and vmid in accordance with:

10 $umid = c / Wmid$

$vmid = c' / Wmid$

where umid and vmid are the texture coordinates for said midpoint.

16. A computer readable memory unit as described in Claim 10

15 wherein for a given pair of adjacent vertices, A and B, said step (b)
comprises the steps of:

(b1) dividing a perspective term associated with vertex A with a
perspective term associated with adjacent vertex B to obtain a first
perspective ratio associated with said given pair of adjacent vertices; and

20 (b2) dividing said perspective term associated with vertex B with said
perspective term associated with adjacent vertex A to obtain a second
perspective ratio associated with said given pair of adjacent vertices.

17. In a computer controlled graphics display system wherein

25 objects are represented by data structures defining a plurality of polygons
and texture data defining surface characteristics of said object, a method for
subdividing polygons having a high degree of perspective, said method
comprising the steps of:

31

(a) selecting, from said computer memory, a selected polygon from said plurality of polygons, said selected polygon comprising at least three vertices wherein each vertex has a perspective term, W, associated therewith that defines a display perspective of said associated vertex with respect to a given viewing angle;

(b) determining perspective ratios for each pair of adjacent vertices of said at least vertices of said selected polygon;

(c) subdividing said selected polygon to generate a plurality of new polygons provided any of said perspective ratios exceeds a preselected perspective threshold amount, wherein said step (c) comprises the steps of:

(c1) dividing said selected polygon into four new polygons provided three edges of said selected polygon have perspective ratios exceeding said preselected threshold amount;

(c2) dividing said selected polygon into three new polygons provided only two edges of said selected polygon have perspective ratios exceeding said preselected threshold amount; and

(c3) dividing said selected polygon into two new polygons provided only one edge of said selected polygon has a perspective ratio exceeding said preselected threshold amount; and

(d) rendering and displaying said selected polygon on a display screen of said computer controlled graphics display system provided none of said perspective ratios exceeds said preselected perspective threshold amount.

25 18. A method as described in Claim 17 further comprising the steps
of:

 (e) repeating said steps (a)-(d) for each polygon of said plurality of
polygons; and

(f) repeating said steps of (a)-(c) for each new polygon generated by said step (c).

19. A method as described in Claim 17 wherein said step (c1)
5 comprises the step of inserting three mid-points between adjacent vertex
pairs of said selected polygon to constitute new vertices for said four new
polygons, wherein said step (c2) comprises the step of inserting two mid-
points between adjacent vertex pairs of said selected polygon to constitute
new vertices for said three new polygons, and wherein said step (c3)
10 comprises the step of inserting one mid-point between one adjacent vertex
pair of said selected polygon to constitute a new vertex for said two new
polygons.

20. A method as described in Claim 17 wherein for a given pair of
15 adjacent vertices, A and B, said step (b) comprises the steps of:
 (b1) dividing a perspective term associated with vertex A with a
 perspective term associated with adjacent vertex B to obtain a first
 perspective ratio associated with said given pair of adjacent vertices; and
 (b2) dividing said perspective term associated with vertex B with said
20 perspective term associated with adjacent vertex A to obtain a second
 perspective ratio associated with said given pair of adjacent vertices.